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# THE ROLE OF NON-LETHAL TECHNOLOGIES IN OPERATIONS OTHER THAN WAR

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June 1996






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# PREFACE

Lexi Alexander and Julia Klare are professional staff members at the Institute for Defense Analyses (IDA). The work reported in this document was conducted under IDA's Central Research Program. Its publication does not imply endorsement by the Department of Defense or any other government agency, nor should the contents be construed as reflecting the official position of any government agency.

The authors wish to thank their many colleagues whose advice and assistance were indispensable to the completion of this document, including Dr. Jeff Grotte, Mr. Mike Leonard, and Mr. Doug Schultz. Ms. Shelly Smith edited the document. Any errors should be solely attributed to the authors.

# CONTENTS

# EXECUTIVE SUMMARY

## PURPOSE

This paper assesses the potential applications of non-lethal technologies for certain operations other than war.

## BACKGROUND

With the end of the Cold War, multilateral intervention operations to help contain or reduce violence and suffering are occurring with increasing frequency. Although the U.S. military refers to these missions as "operations other than war" (OOTW), deployments to places like Bosnia, Somalia, and Haiti are not always conducted under a peaceful mantle. Often the humanitarian crises that precipitate international attention result from unstable political leadership; internal religious, cultural or ethnic unrest; or hostile, potentially armed opposition to local government.

In the midst of this volatile and unpredictable environment, the omnipresent civilian, demanding humanitarian assistance and protection from U.S. soldiers, complicates the conduct of military operations. This civilian presence and the noncombatant nature of the mission often leads U.S. policymakers to adopt restrictive rules of engagement constraining the use of lethal force. Unfortunately, hostile indigenous forces opposed to outside intervention are aware of U.S. reluctance to cause civilian casualties. Thus these forces have an enormous incentive to exploit the civilian population in an attempt to leverage their own military capabilities. During Operation Restore Hope, Somali gunmen frequently used women and children as human screens from behind which they could attack U.S. forces. Today, responding to these tactics creates a dilemma: U.S. soldiers can either respond with lethal force and risk wounding or killing noncombatants (potentially inflammatory or politically untenable), or do nothing and increase the risk to themselves. Thus the challenge is to provide better protection to U.S. forces and limit the risk of civilian casualties while still accomplishing political and military objectives.

Non-lethal technologies may help meet this challenge. If the application of force is viewed along a continuum, rather than as a "yes" or "no" proposition, non-lethal

technologies fill the gap between doing nothing on the one hand, and using lethal force on the other. Thus they may provide military commanders a wider range of options for applying force consistent with or proportional to the threat.

## METHODOLOGY

Our assessment is based primarily on a series of case studies. Given the project's limited resources, we did not conduct a comprehensive, bottom-up assessment of OOTW requirements; rather we sought to match existing capabilities to missions in order to find a few test cases for the use of non-lethal systems. Our goal was to identify either potential gaps in U.S. capabilities for conducting peacekeeping operations, or areas where non-lethal technologies could potentially enhance current capabilities. Previous IDA studies, as well as anecdotal evidence from the military personnel we interviewed, suggested three areas where non-lethal technologies had potential: controlling crowds, countering harassing mortar fire, and conducting perimeter security.

Examining these cases in turn, we looked first at the operational context and operational requirements for each. From the operational context, we derived a number of desirable performance characteristics that could be used as criteria for evaluating the potential applicability of candidate technologies. While we focused primarily on operational criteria, we examined logistical and political criteria as well. We then qualitatively assessed whether candidate technologies met the postulated criteria and, of those that did, which seemed most promising.

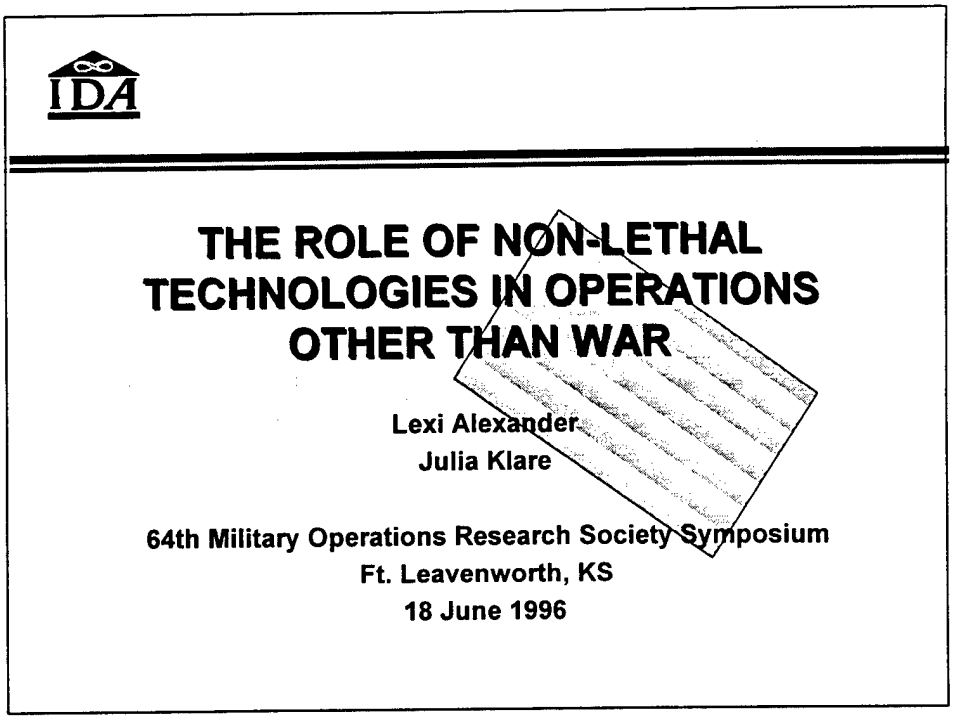
## RESULTS

Our assessment of the three cases clearly demonstrated the need to evaluate non-lethal technologies in the operational context in which they will be used. We found that even missions with apparently similar objectives had quite different operational requirements. These various requirements in turn drive technology solutions in different directions. Although many of the technologies that we examined have applications in all three cases, we did not discover any "silver bullet" technology that met all postulated requirements. While the non-lethal technologies we examined can help to fill some gaps in our capabilities to conduct crowd control, countermortar, and perimeter security operations, it is not clear that they can fill all of the holes. Moreover, many of the currently available non-lethal technologies are potentially handicapped by weather constraints or an opponent's use of available countermeasures, especially against short-

range systems. These factors pose particular problems for crowd control operations, which, of the three operations we examined, will be conducted at shortest range. Finally, in any cases where non-lethal technologies can contribute, our assessment shows that the development and use of non-lethal systems will have associated logistics and political costs that need to be carefully considered. As non-lethal weapons capabilities expand, policymakers and military commanders need to more systematically assess these factors.

## LIMITATIONS

We view the work presented in this document as the first step toward gaining a real understanding of the utility of non-lethal technologies in operations other than war. Our assessment is purely qualitative; we now need to develop methods and tools to better measure the effects of these technologies in the roles we have assigned them. We also assumed that all technologies worked as predicted; such an assumption is optimistic for technologies at such an early stage of development. In addition to the methods and tools identified above, we believe there is a need for assessment of technical feasibility, technical risk, and budgetary implications.




This document contains an annotated version of a presentation given at the 64th Military Operations Research Society Symposium, held at Ft. Leavenworth, KS on 18–20 June 1996.

## I. INTRODUCTION

We begin by defining "non-lethal technologies" as used in this document, and discussing why non-lethal technologies are interesting and potentially important in many military missions. In doing so we touch on the current status of non-lethal technology development and provide some examples of anti-personnel and anti-materiel non-lethal technologies.

## What Are Non-Lethal Technologies?

**DEFINITION:**

**Non-lethal weapons are explicitly designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment.**

**INTENT is critical**

**TERMINOLOGY was long debated**

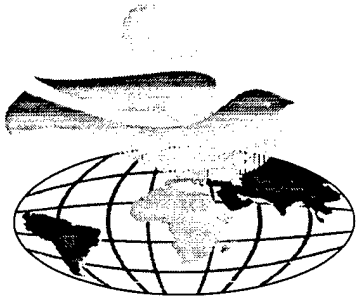
- USAF: sublethal
- USMC, law enforcement: less lethal
- Others: pre-lethal, less-than-lethal, soft kill

This slide provides the definition of non-lethal technologies officially adopted by the Department of Defense in DoD Directive 3000.3, *Policy for Non-lethal Weapons*, 9 July 1996.

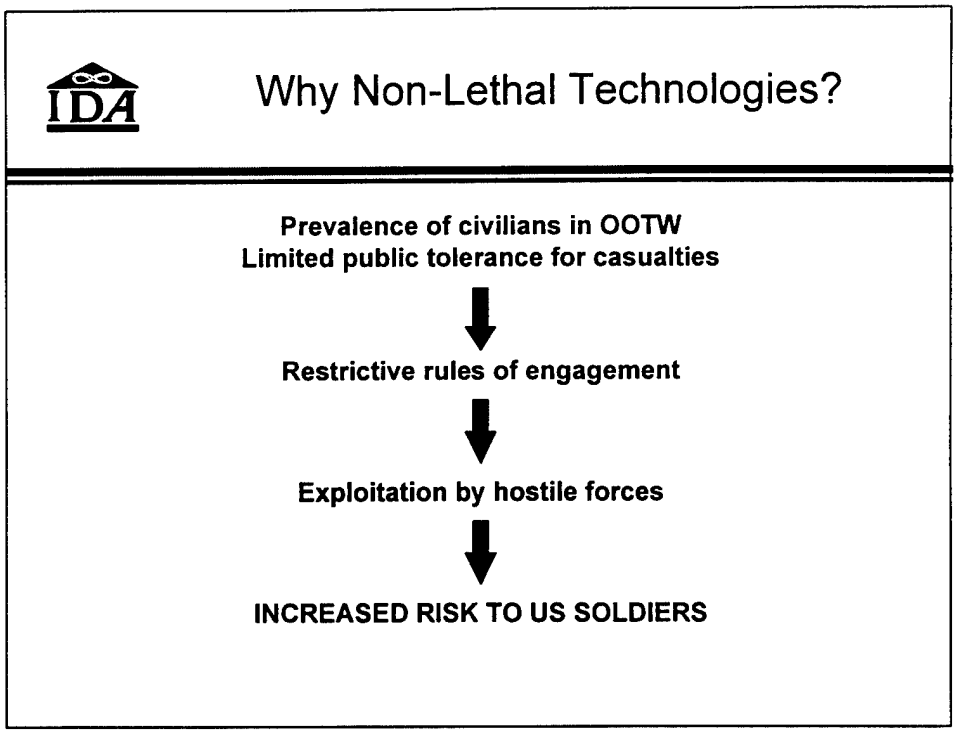
Implicit in this definition is the notion that it is the *intent* to avoid lethality, not the consequences of use, that make a given technology "non-lethal." In fact, while non-lethal systems are not meant to be fatal, most can have lethal consequences if used improperly or against individuals particularly susceptible to their effects. For example, taser electric shock devices are much more likely to kill individuals with pacemakers than individuals with healthy hearts. Moreover, many systems considered "non-lethal" are designed to cause significant bodily trauma. Wooden baton rounds and other forms of semi-penetrating ammunition can cause broken bones and surface wounds serious enough to require hospitalization.

## OOTW Missions

- **Humanitarian assistance**
- **Cease-fires, truces**
- **Demilitarization**
- **Withdrawals**
- **Orderly transfers of power**
- **Post-conflict reconstruction**
- **POW exchanges**



A variety of missions might be conducted under the auspices of operations other than war (OOTW). Each is very different, with different objectives and requirements. Yet all rely heavily on the support of military forces, particularly American military forces, for success. Few organizations other than the U.S. military have the resources or capability to provide the organizational and logistics support these missions need.




With the end of the Cold War, multilateral intervention operations to help contain or reduce violence and suffering are occurring with increasing frequency. Although the U.S. military refers to these missions as "operations other than war (OOTW)," they are not always conducted under a peaceful mantle. Often the humanitarian crises that precipitate international attention result from unstable political leadership; prevailing religious, cultural, or ethnic unrest; or hostile, potentially armed opposition to local government. In such a volatile and unpredictable environment, the omnipresent civilian, demanding humanitarian assistance and protection from U.S. soldiers, complicates the conduct of military operations. This civilian presence and the noncombatant nature of the missions motivates the United States to adopt restrictive rules of engagement constraining the use of lethal force.

Yet hostile indigenous forces, aware of the U.S. reluctance to harm civilians, have enormous incentives to exploit civilian populations, using them as protective shields, as bargaining chips, and as a means of compensating for their lack of conventional military capability. Ultimately, the U.S. desire to avoid hurting civilians can increase the risk to soldiers involved in OOTW missions.

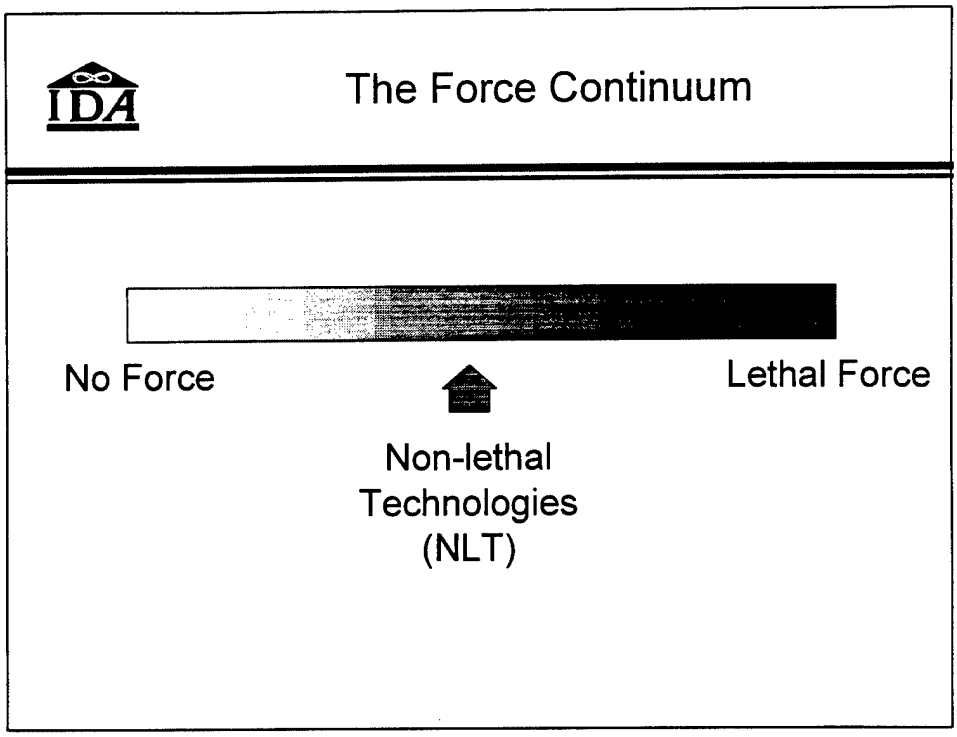
## A Scenario

**"Tonight we are supposed to get hit by 150 gunmen. The men are said to have women and children holding hands walking in front of the gunmen as they shoot--sort of a human shield...I'm scared, real damn scared."**

*--Private First Class Richard Kowalewski, 20, U.S. Army Ranger killed in action in Mogadishu*

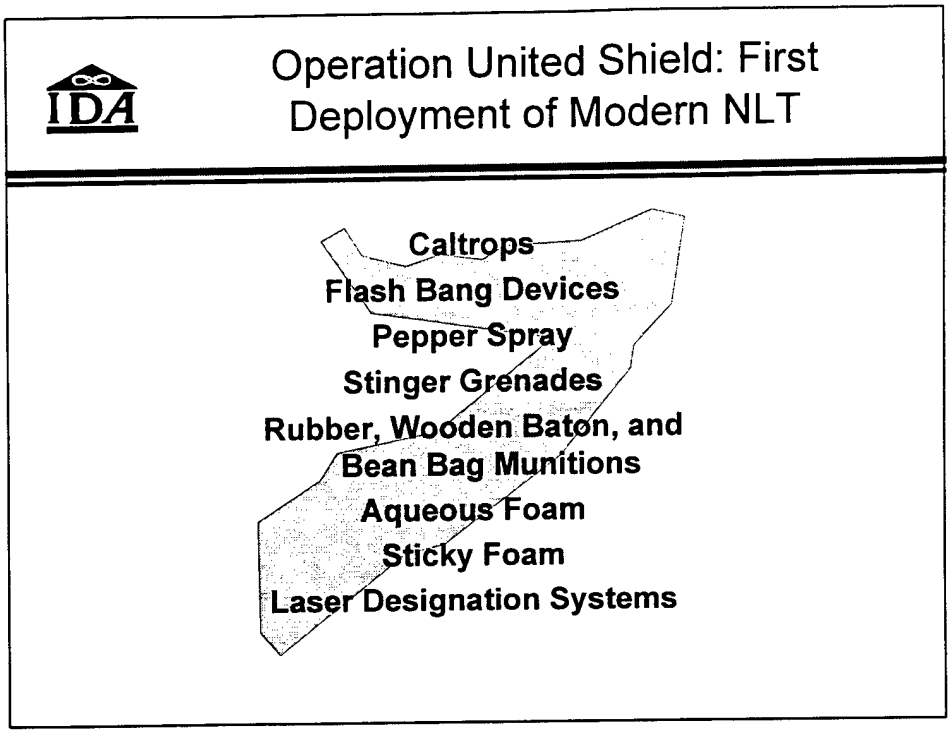
This slide vividly illustrates the real risks to U.S. soldiers participating in operations other than war.[1] This tactic of using noncombattants as human shields proved very effective in Somalia. U.S. forces may see tactics such as these in future operations.

1 *Time* excerpted PFC Kowalewski's letters home in its October 18, 1993, issue.




Today, U.S. military forces have few good options for responding to situations like the one described by PFC Kowalewski. In cases where lethal force is restricted by the risk of casualties and collateral damage, the challenge is to improve our ability to accomplish missions while providing better protection for U.S. soldiers.

Non-lethal technologies can meet this challenge by offering military commanders a means of applying force proportional to the threat. The use of force would no longer be a "yes" or "no" proposition. Rather, as illustrated in this simple graphic, force can be seen as a continuum, with non-lethal technologies filling the gap between doing nothing and using lethal force.




In February 1995, the U.S. Marine Corps' I[st] Marine Expeditionary Force landed in Somalia to support the final withdrawal of UN forces from that country—Operation United Shield. In addition to providing needed assistance, the India Company of the I[st] MEF achieved a technological milestone—it was the first U.S. military unit to train and deploy with modern non-lethal technologies. The systems deployed with the unit are listed in this slide.[2] All were off-the-shelf items, acquired from domestic law enforcement organizations and U.S. Army Armaments Research, Development and Engineering Center (ARDEC), which was then beginning its non-lethal technology development program. Although ultimately only two of these systems were used—sticky foam and laser designation systems—the Marine Corps emerged from United Shield with enormous enthusiasm for non-lethal (or, in the Marine Corps parlance, "less lethal") technologies. In fact, the Marines attributed much of the peacefulness of the operation to the deterrent effect of these systems on the Somali population.

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2 Commanding General, I Marine Expeditionary Force, FMF, Memorandum to Commanding General, Marine Corps Combat Development Center, Quantico, VA 22134, Subject LESS LETHAL, reference number 3000, G-3/0162, 2 Jun 95, pp.15–16.

## Old Concept--New Emphasis

**DoD Directive, Policy for Non-Lethal Weapons, ASD(SO/LIC), 9 July 1996**

**Congressionally mandated OSD technology development program**

- $37 million authorized but not appropriated
- Marine Corps designated lead March 1996
- Focus on near-term development

**Independent Service efforts**

- US Army ARDEC is primary materiel developer

**Currently deployed systems (Bosnia, Haiti) are off-the-shelf law enforcement equipment**

Non-lethal technologies are not new. Military forces have used riot-control agents, defoliants, and rubber bullets for decades. Yet with the increased participation of U.S. military forces in OOTW has come renewed interest within and outside government in advancing the state of the art in non-lethal technologies.

This renewed interest is reflected in the various congressional and DoD activities shown in this slide. The Department of Defense recently published a new policy on non-lethal weapons.[3] The DoD Senior Steering Committee for Non-lethal Weapons, established in 1991, has developed an acquisition plan for non-lethal technology development and procurement. Congress has approved the acquisition plan and authorized its funding, but political and budget problems have held up further progress.[4] Under congressional pressure, OSD designated the Marine Corps to act as executive agent for the program in March.

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3 Department of Defense Directive, Number 3000.3, *Policy for Non-Lethal Weapons*, ASD(SO/LIC), 9 July 1996.

4 "NATO Group Pushes, Pentagon Pulls Nonlethal (sic) Efforts," *Defense News*, April 29–May 5, 1996.

At the same time, the military Services, particularly the Army and Marine Corps, are actively working to improve their non-lethal capabilities. The U.S. Army's ARDEC serves as the primary materiel developer for both the Army and Marine Corps.[5]

Finally, the Army is equipping units involved in operations in Haiti and Bosnia with off-the-shelf non-lethal systems, developed primarily for use by U.S. law enforcement organizations.[6]

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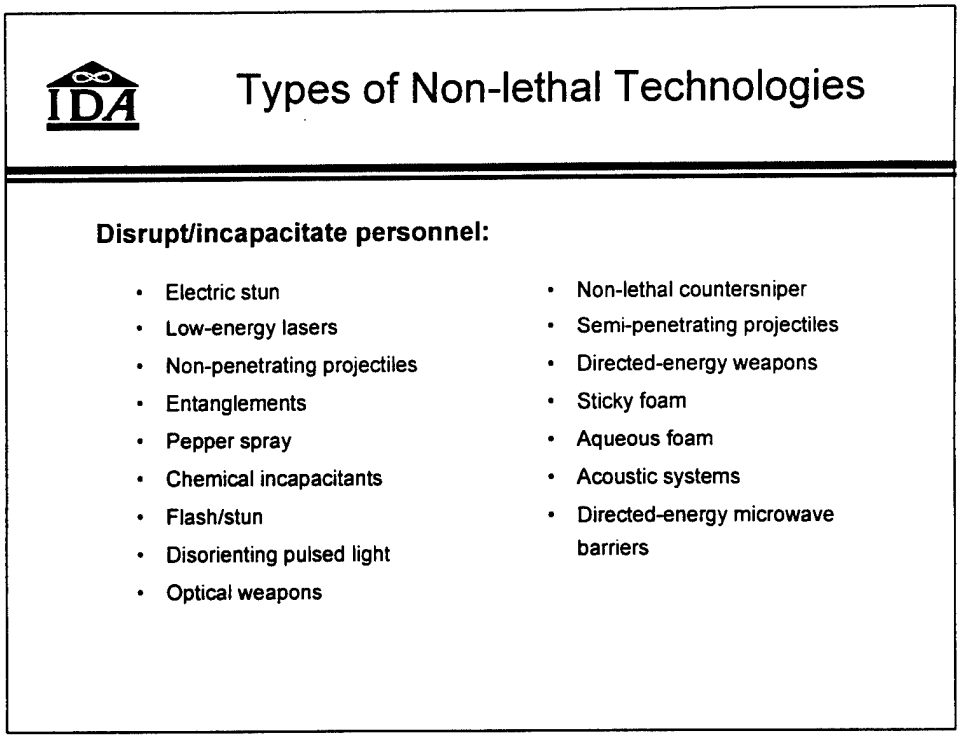
5 Briefing by MAJ Jack Supplee, Deputy Systems Manager, Non-Lethal Program, U.S. Army ARDEC, Close Combat Armaments Center, "Non Lethal/Less-than-Lethal/Low Collateral Damage Munitions Program," presented to the authors 17 August 1995.

6 "Army Directs Procurement of Non-Lethal Technologies for Use in Bosnia," *Inside the Army*, 15 April 1996; and authors' telephone conversation with SGT Irvin Schiff, U.S. Army Military Police School, Ft. McClellan, AL, 4 April 1996.




This slide and the one following list examples of non-lethal technologies, divided into two categories: anti-personnel technologies and anti-materiel technologies. In this slide, anti-personnel technologies have been further divided into categories based on their effects on humans.[7]

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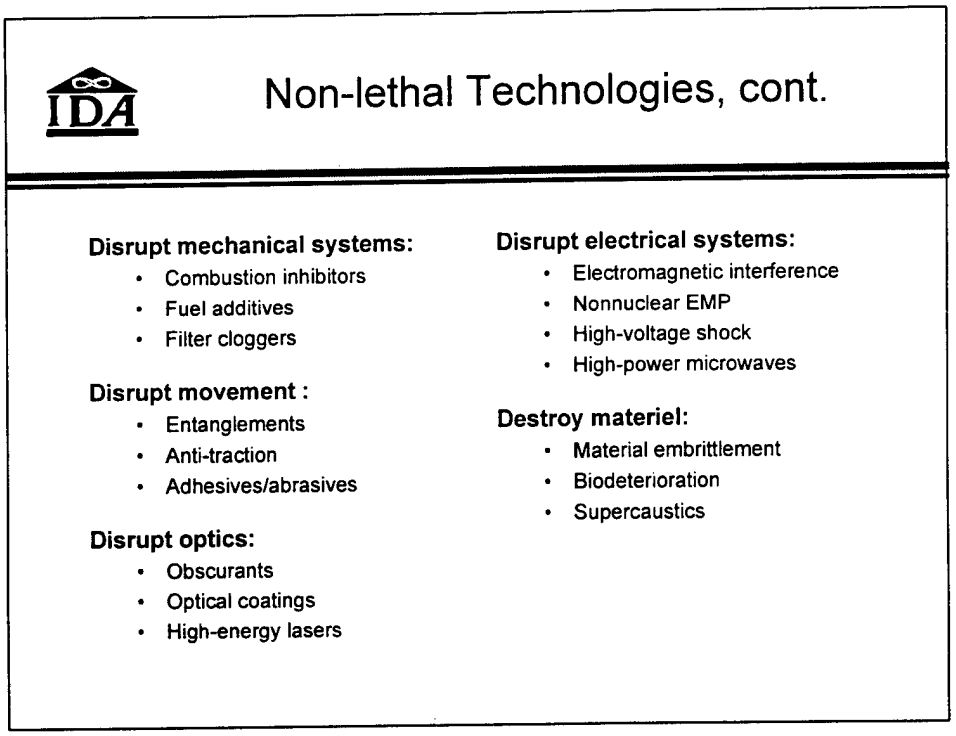
7 Taken from Appendix, U.S. Army TRADOC Pam 525-XX, "Draft Concept for Non-lethal Capabilities in Army Operations," August 1995.




This slide provides additional examples of non-lethal technologies. It shows anti-materiel technologies categorized by their ability to target various systems and components.[8]

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8 Ibid.

## II. NON-LETHAL TECHNOLOGIES AND OPERATIONS OTHER THAN WAR

Having defined our topic and put it into context, we now turn to the main discussion of the role of non-lethal technologies in operations other than war.


## Outline

**Approach**

**Case Studies**

**Limitations, Summary and Conclusions**

The discussion is divided into three sections: 1) analytic approach; 2) assessment of non-lethal technologies; and 3) limitations of our approach, summary of the work, and conclusions.

## Approach: Select Case Studies

**Are there areas where non-lethal technologies can fill gaps or improve existing capabilities?**

**Recent IDA task work examined perceived gaps in US peace support capabilities**

- Somalia
- Bosnia

**We found three areas where non-lethal technologies might be useful:**

- Controlling crowds
- Countering harassing mortar fire
- Maintaining a protected zone

## A. APPROACH

In conducting our assessment of the role of non-lethal technologies in OOTW missions, our goal was to identify current capability gaps or areas where non-lethal technologies could potentially enhance current capabilities. Given our limited resources, we did not intend to conduct a comprehensive, bottom-up assessment of OOTW requirements; rather we sought to match existing capabilities to missions in order to find a few test cases for the use of non-lethal systems.

To do this, we focused primarily on areas in which previous IDA studies had identified potential gaps in U.S. capabilities for conducting peacekeeping operations. These studies suggested three specific capabilities that could be enhanced through the use of non-lethal technologies: controlling crowds, countering harassing mortar fire, and maintaining a protected zone.

## Approach (cont.)

**FOR EACH CASE STUDY,**

**Define operational context**

**Derive evaluation criteria**
- Operational, logistical, political

**Identify relevant technologies**

**Conduct qualitative assessment**

**Determine which technologies are most promising**

Once we had selected the capabilities on which we would focus, we examined the operational context in which they would be used. From the operational context, we derived a number of desirable performance characteristics that could be used as evaluation criteria. We then identified the set of most relevant non-lethal technologies and compared them using our postulated criteria in order to determine which were most promising. Given the resources available to us, our assessments thus far have been purely qualitative; no attempts have yet been made to measure the benefits of using non-lethal technologies in the operational contexts we have described.

## B. ASSESSMENT CASE I: CROWD CONTROL

We now present our detailed assessment of non-lethal technologies for each case study. Crowd control operations are discussed in some detail; the other two cases, abbreviated to "countermortar" and "perimeter security," are discussed more briefly and are used to further illustrate some of the points made in the crowd control case.

## Crowd Control Objectives

**DETER or PREVENT crowd formation**

***But, failing that...***

**CONTROL, contain and/or neutralize crowds**

- Identify, isolate, and neutralize hostile elements
- Enable vehicle passage through dense/hostile crowd
- Neutralize snipers
- Free hostages

**DISPERSE crowds**

What are the objectives of crowd control operations? Obviously, we would like to prevent crowds from forming if we can, either by deterring them or by placing physical barriers along main routes leading to areas of concern. But preventing crowd formation requires some indication that a crowd is in fact likely to form so that such actions can be taken. Given that the events that spark crowds are often difficult to predict, such foreknowledge is probably rare. At the same time, some crowds form regularly, such as those in marketplaces. In operations other than war, efforts to prevent these crowds from forming are likely to be too disruptive to local economies and civilian lifestyles to be politically feasible.

If we can't prevent crowds from forming, then we must control them in ways that protect bystanders, property, and nearby U.S. forces. Hostile elements, attempting to incite the crowd or to use the crowd as cover for attacks on U.S. forces, must be neutralized without harm to innocents. If snipers are present, they must be neutralized as well. In cases like Haiti, where crowds may form around vehicles to strip their contents, free passage for those vehicles needs to be maintained. If elements of the crowd have taken hostages, those hostages must be freed.

Finally, once crowds have formed, they must be dispersed as soon as they show signs of becoming dangerous or if their presence inhibits the U.S. from conducting operations.

## Crowd Control Requirements vis-a-vis Objectives

**Prevent crowd formation**

- Long range
- Area coverage and point targeting
- Low end of force continuum

**Control crowds**

- Short range
- Point targeting
- Span force continuum

**Disperse crowds**

- Short range
- Area coverage
- Low end of force continuum

For each crowd control objective, we can postulate some general operational requirements that any supporting capability would have to meet. For example, given that people may converge from far away and via a wide variety of routes, systems to prevent crowd formation should have relatively long ranges. They should be able to cover wide areas, to engage large numbers of people, and to single out leaders as they move along approach routes. Likewise, since the gathering crowd does not yet pose a real threat, systems should be at the lower end of the force continuum. At this stage of crowd control operations, hurting people is not necessary and may well be counterproductive.

Once crowds have formed, controlling them will require short-range systems. We asked the military police about the optimal distance between military forces and crowds and inquired whether stand-off systems might be useful in meeting this objective. The police stated a distinct preference for the deterrent effect of forces on site, at a distance of 20 to50 meters from the crowd.[9] Since the transition within crowds from peaceful to dangerous typically occurs at the instigation of individuals, supporting systems need to be able to single out those individuals from the rest of the crowd. The more hostile they

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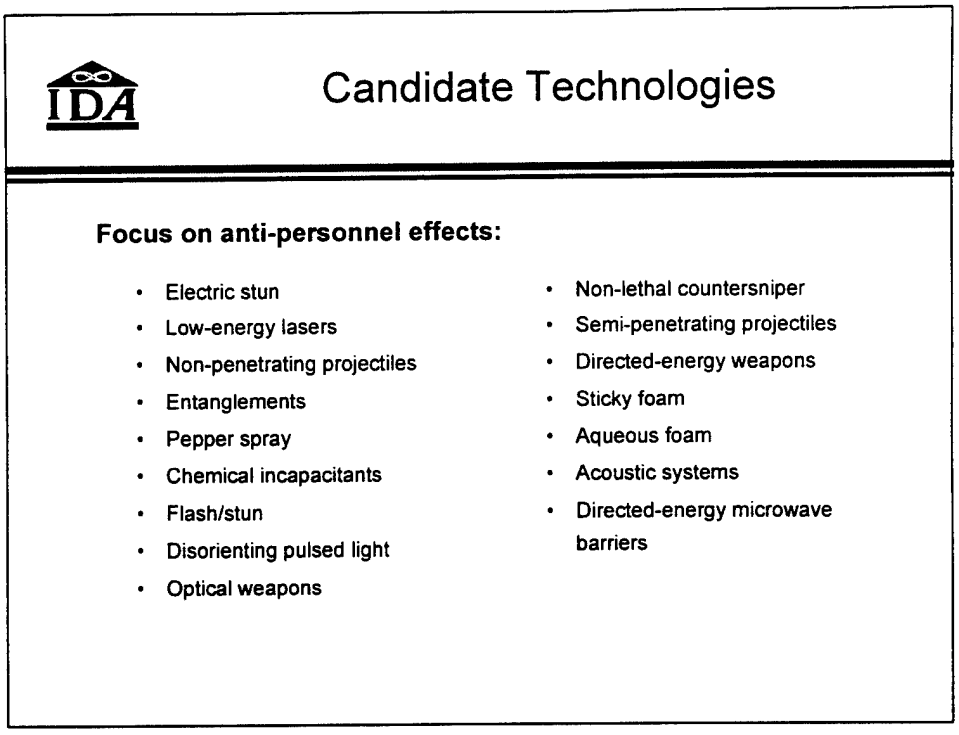
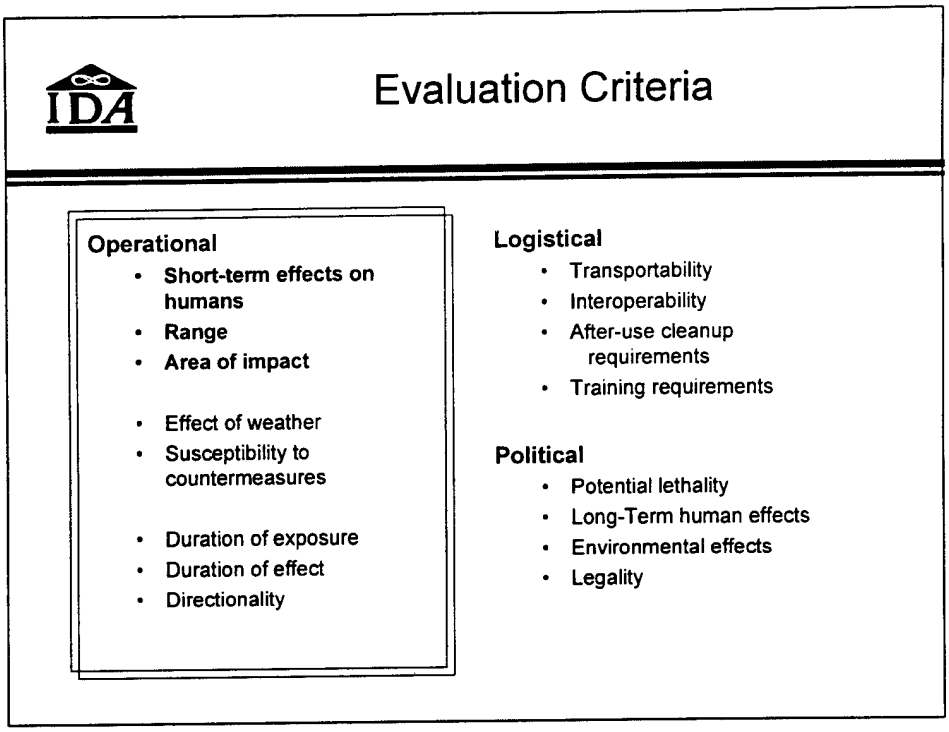
9 Authors' telephone conversation with SGT Irvin Schiff, U.S. Army Military Police School, Ft. McClellan, AL, 4 April 1996.

become, the further along the force continuum the response should be. These factors are also true in cases where hostile forces are prepared to exploit crowds to attack U.S. forces, as in the scenario described by PFC Kowalewski.

Finally, systems used to disperse crowds need to target large groups of individuals in order to have the intended effect. Still, because the majority of crowd members are likely to be benign, systems should stay at the lower end of the force continuum. And because the systems will be employed by forces near the crowd, they need to have short ranges.




Because crowd control operations are in essence anti-personnel operations, we chose as our set of candidate technologies the list of anti-personnel technologies presented earlier. This list is shown again in the slide above.

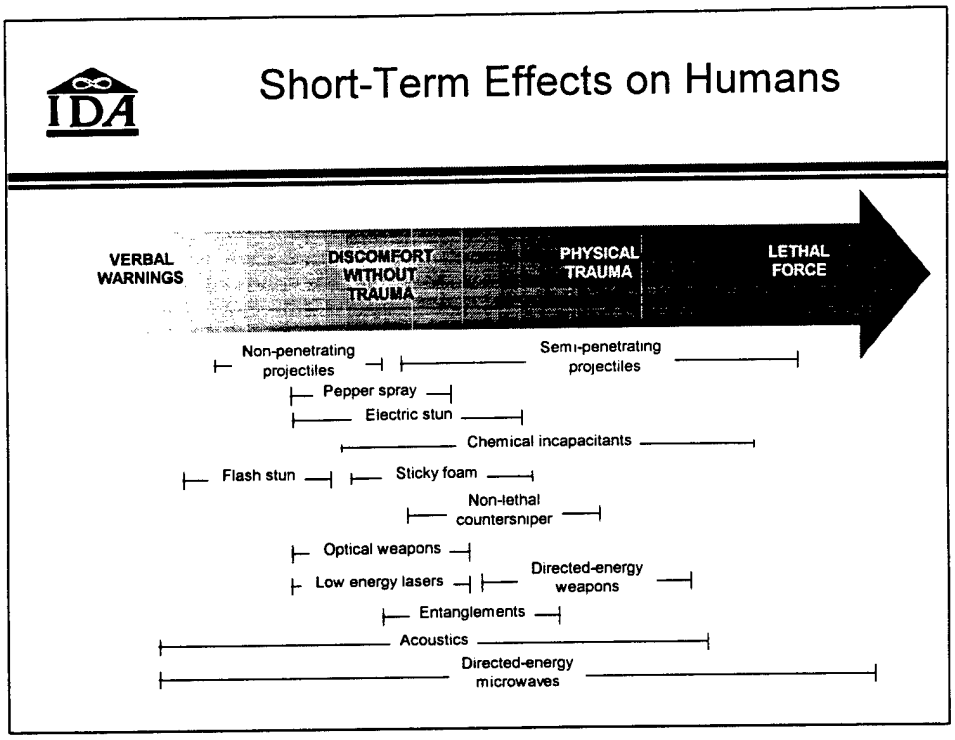



This slide shows the evaluation criteria we used to determine which if any of the technologies listed in the preceding slide could be usefully applied to crowd control operations. Most important are the first three operational criteria, which we derived from our crowd control objectives, as described earlier. Other operational criteria include effects of weather, since crowd control operations are generally conducted outdoors; susceptibility to countermeasures; duration of exposure and effect; and directionality, since the user would like to avoid affecting his own forces.

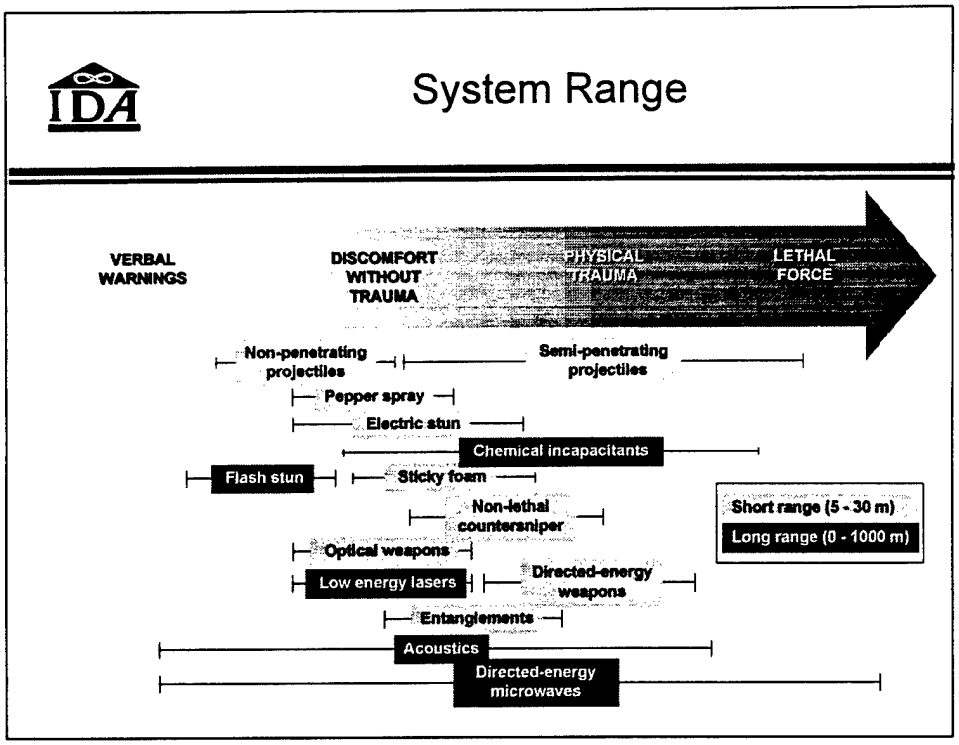
In addition to operational criteria, a number of logistical and political criteria are important in any assessment of technologies. From a logistics standpoint, how easy are these systems to deploy? How interoperable are they with other systems? For example, do stinger grenades require special launchers, or can they be shot from general issue weapons? How much training is required before troops can use the system? This is very important in a peacekeeping environment, where rules of engagement may be confusing and troops need to integrate new systems into their traditional, lethal equipment. Once used, how much clean-up is required?

Political factors also loom large in operations other than war. In particular, the need to avoid unnecessary casualties, in both the near and long terms, is paramount.

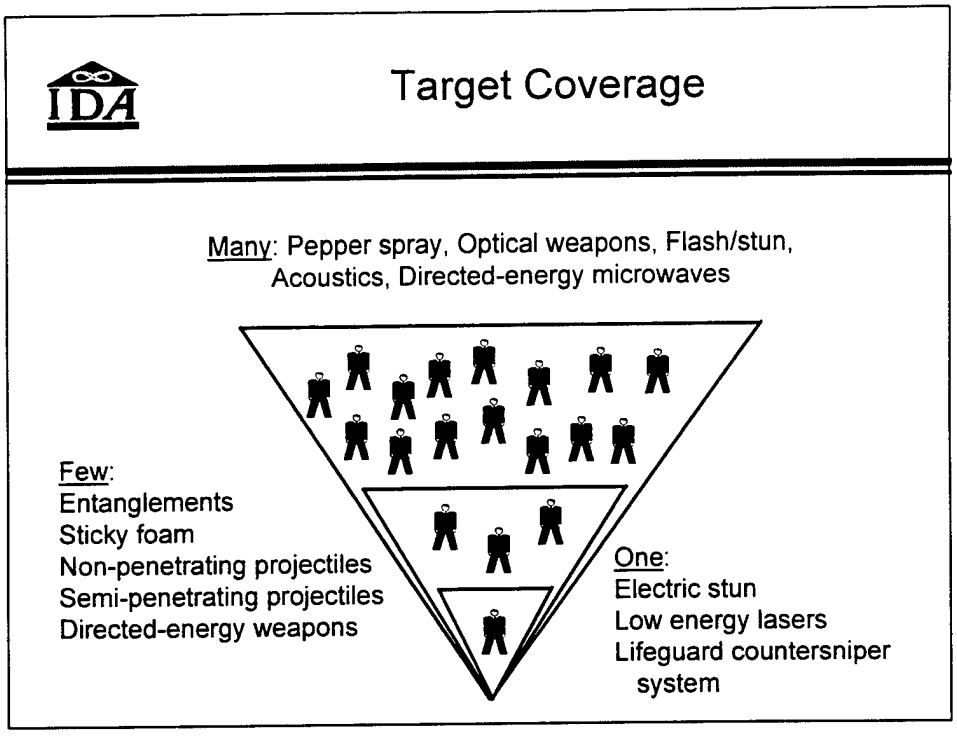
Likewise, environmental damage needs to be avoided if possible. Finally, many non-lethal technologies, such as chemical incapacitants and laser weapons, may be subject to international arms control agreements, thus restricting their use in these missions.



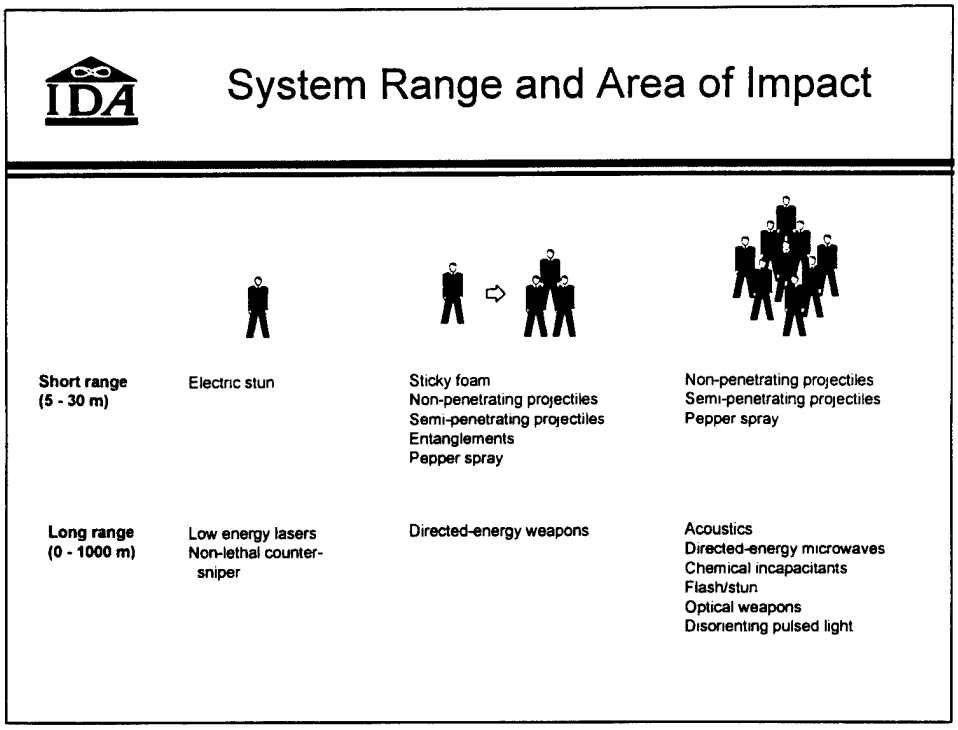

To show how the technologies under consideration affect humans in the short term, we have taken our force continuum concept and added examples of the effects of different types of force at various stages. These effects range from none, in the case of verbal warnings, through various stages of discomfort and trauma to lethal force. Some systems have effects that are tunable, like electric stun systems, or that vary depending on proximity, such as directed-energy microwaves. As we can see, these technologies span the breadth of the force continuum quite well.



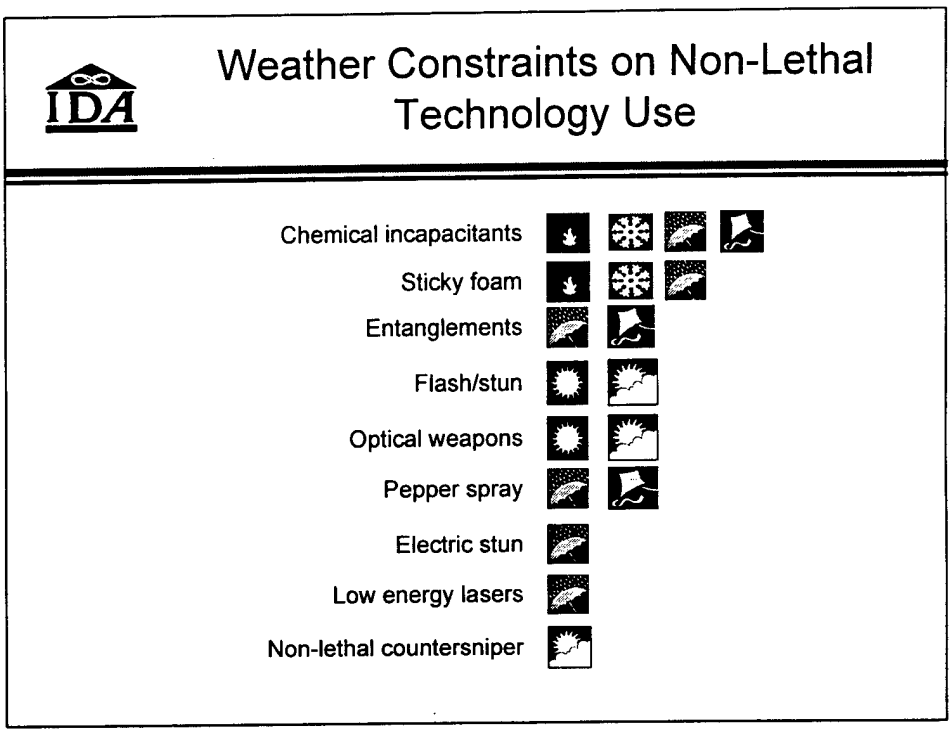

This slide shows the approximate ranges associated with various technologies. Those with long ranges are candidate technologies for preventing crowds from forming; the remainder are candidates for controlling and dispersing crowds. This categorization is not completely discrete, however, since many of the longer range systems can be used at short ranges as well. However, in some cases, such as acoustics and microwaves, the effects at short ranges are much different than they are at longer ranges. Finally, the ranges of some systems are really determined by the delivery system; chemical incapacitants, for example, can obviously be used at great ranges if delivered via aircraft or missile, and very short ranges if dispensed from hand-held sprayers.




Here we show the target coverage offered by various technologies, ranging from point systems that affect individuals, to systems that affect one to several people, and finally to systems that affect anyone within the proximate area. Since different objectives require different target coverage, the variation we see within the set of evaluated technologies is desirable.

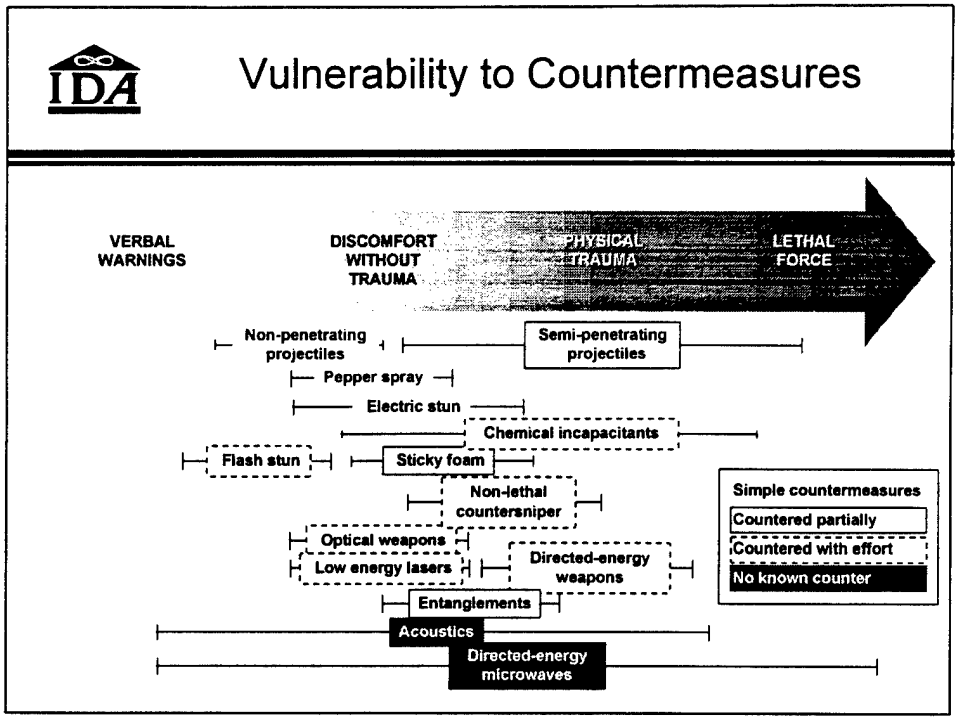



This slide combines two criteria, range and target coverage. We need diverse target coverage at both long and short ranges, and this slide reaffirms that the given set of technologies does not leave any obvious gaps. At the same time, cases where only a few technologies meet a given set of requirements could present a problem, particularly if one or more of those technologies has other vulnerabilities. Here we see that at longer ranges, only three systems can be used against point targets, as opposed to large areas.




Here we depict the effects of weather on the ability of technologies to function properly in a crowd control environment. We looked at the effects of extreme heat, extreme cold, precipitation, wind, bright sunlight, and low visibility. Technologies that do not appear on this slide are unaffected by weather.

The greater the variety of weather conditions to which a technology is vulnerable, the less one can rely on its effectiveness in any given situation. Chemical incapacitants, for example, are very vulnerable; their effectiveness can degrade rapidly under certain conditions. Given the high degree of uncertainty already present in OOTW, such technologies will be much less attractive than those that can be used reliably under all weather conditions.

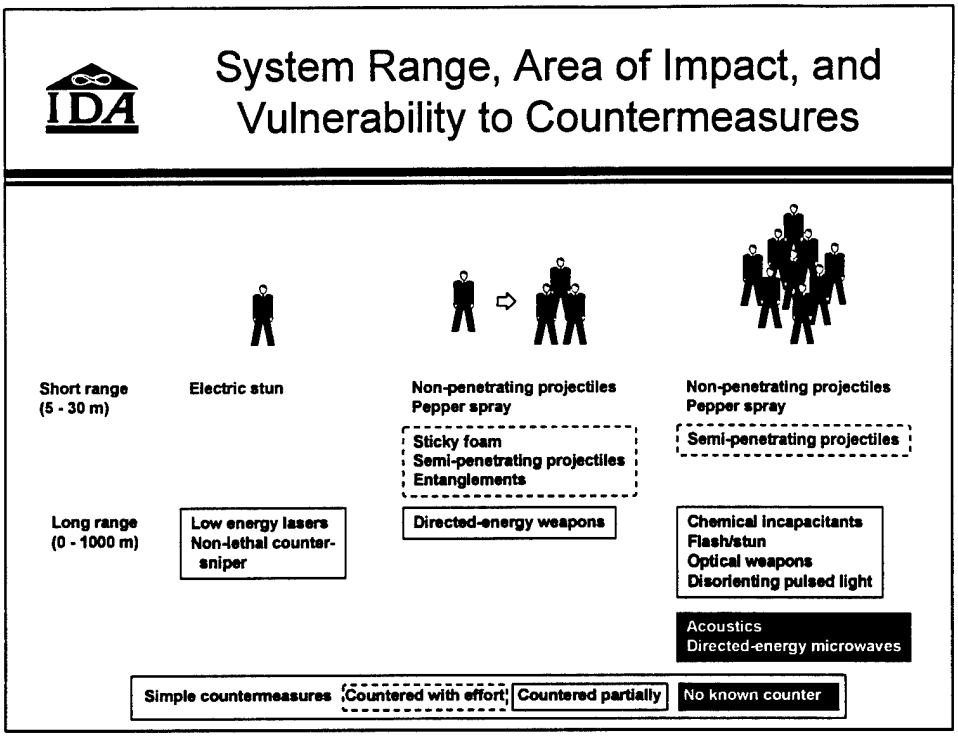



Finally, we looked at the vulnerability of various technologies to countermeasures. Here we assume our enemies are indigenous, locally organized, poorly armed opponents who exploit a civilian environment in part because they cannot compete with our forces in conventional combat. Thus their resources to devote to countermeasures are likely to be limited and low-tech.

We have defined vulnerability to countermeasures in the following way. Some technologies are easy to counter, using simple techniques readily available even to the opponents postulated here. They include things like wearing heavy clothing to deny electric stun devices and wearing simple masks to counter pepper spray. Some things will always have some effect, but those effects can be mitigated to some extent. Knives and scissors might be used to cut through entangling nets; for example, those entangled will still be temporarily captured, but for a shorter period of time than they otherwise would be. Some systems can be completely countered, but only if the opponent is aware of the system and invests time and effort in countering it. Wearing special welding goggles, for example, can deny the effects of many optical systems. However, acquisition and distribution of such goggles may be difficult for poorly organized groups with limited budgets, and may not be seen as worth the investment. Finally, there are some systems that opponents of the type postulated here may never be able to counter.

Certainly, forces of the capability of the former Soviet army could simply destroy acoustic or microwave systems through remote bombardment by aircraft, helicopter gunfire, missiles, and so forth. Such systems are heavy signal emitters and could easily be targeted with smart weapons. Yet for opponents lacking conventional combat capabilities, these options would be unavailable.

As we can see in the above chart on vulnerability, most of the systems at the lowest end of the force continuum are simply countered; those at the highest end are more difficult.




This slide compares technologies by range, area of coverage, and vulnerability to countermeasures. It shows a clear correlation between range and vulnerability: short range systems, those needed for crowd control and dispersal, can all be countered simply, either completely or to some extent. Long range systems, useful for preventing crowds from forming, are much more difficult for our opponents to counter. Given that the majority of crowd control operations are likely to be conducted after crowds have formed, however, this signals a potentially serious deficiency.

## Observations on Operational Assessment

**Programmed technologies span the force continuum**

- Short range technologies tend toward lower end

**Programmed technologies offer a variety of target coverage options**

- Limited ability to discriminate at long range

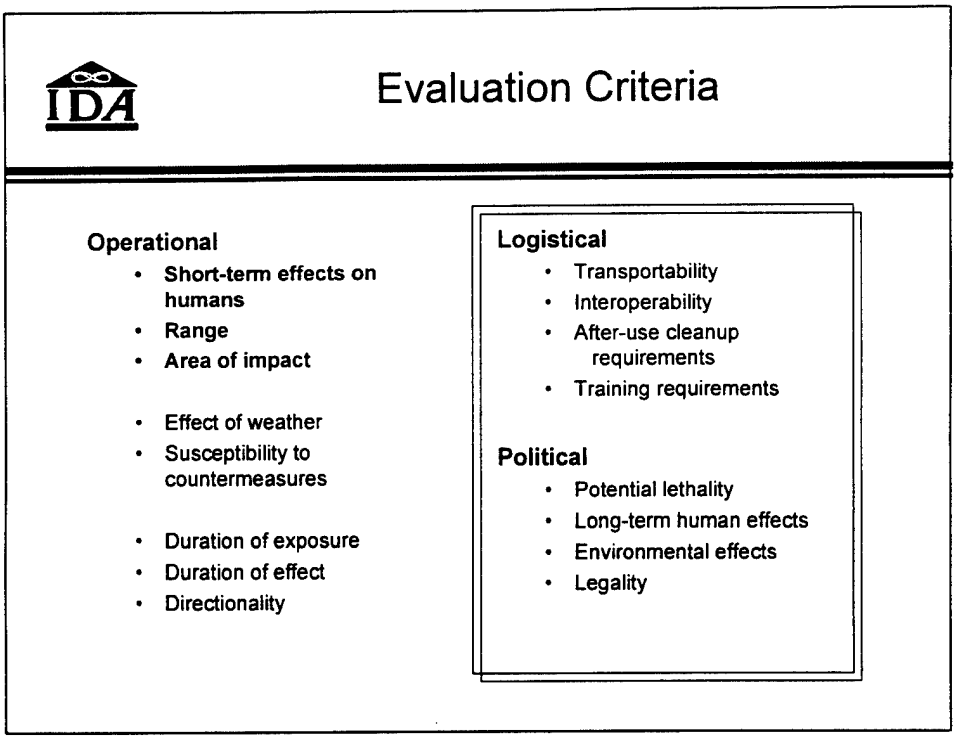
**Use of some technologies heavily constrained by weather conditions**

- Sticky foam
- Chemical incapacitants

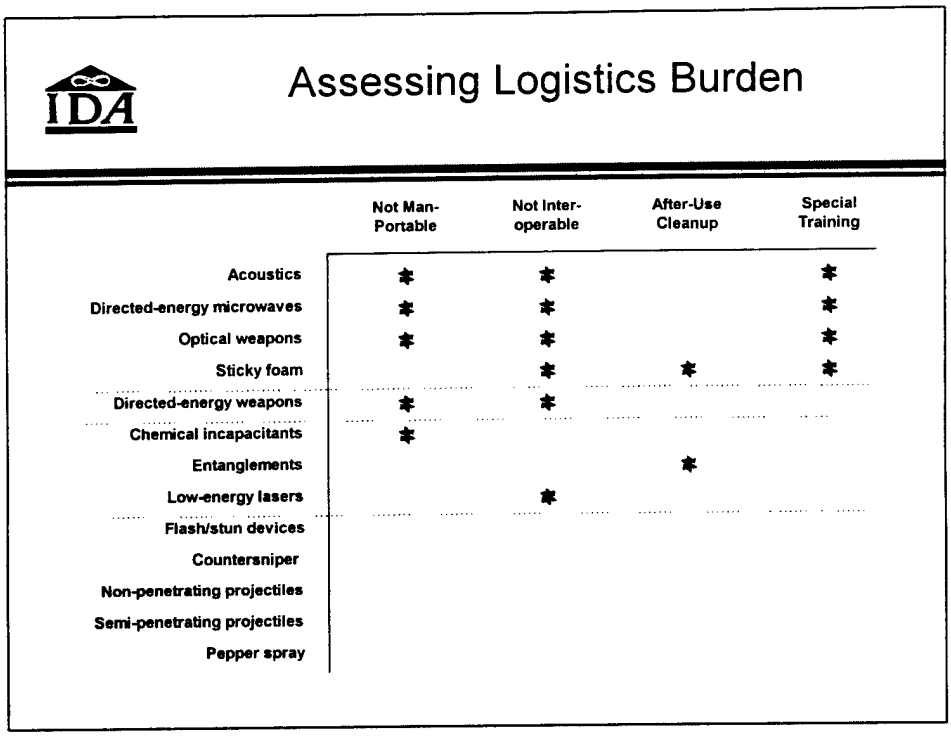
**Short-range technologies most vulnerable to countermeasures**

- Means that most discriminant technologies are vulnerable as well

Here we summarize our observations on the extent to which the examined technologies meet the requirements of crowd control operations.




We next look at the extent to which various technologies have negative logistical or political impacts. The criteria we use are shown again in this slide.




The results of our review of logistics criteria are shown in this summary chart. In essence, we made no attempt to measure the logistics burden of any given technology or to weight any of the criteria. Rather, we simply said that points were assigned for failure to meet each requirement—i.e. that a technology is not man-portable, is not interoperable, requires after-use cleanup, or requires special training. Technologies were then ranked in reverse order based on the number of points they received. Those with three points are considered to pose a greater logistics burden than those with fewer points. As can be seen in this chart, no technology failed to meet all four criteria, although several failed three, and some met all four.

## Observations on Logistics Burden

**Objective not to measure logistics burden but to determine whether a given technology will create one**

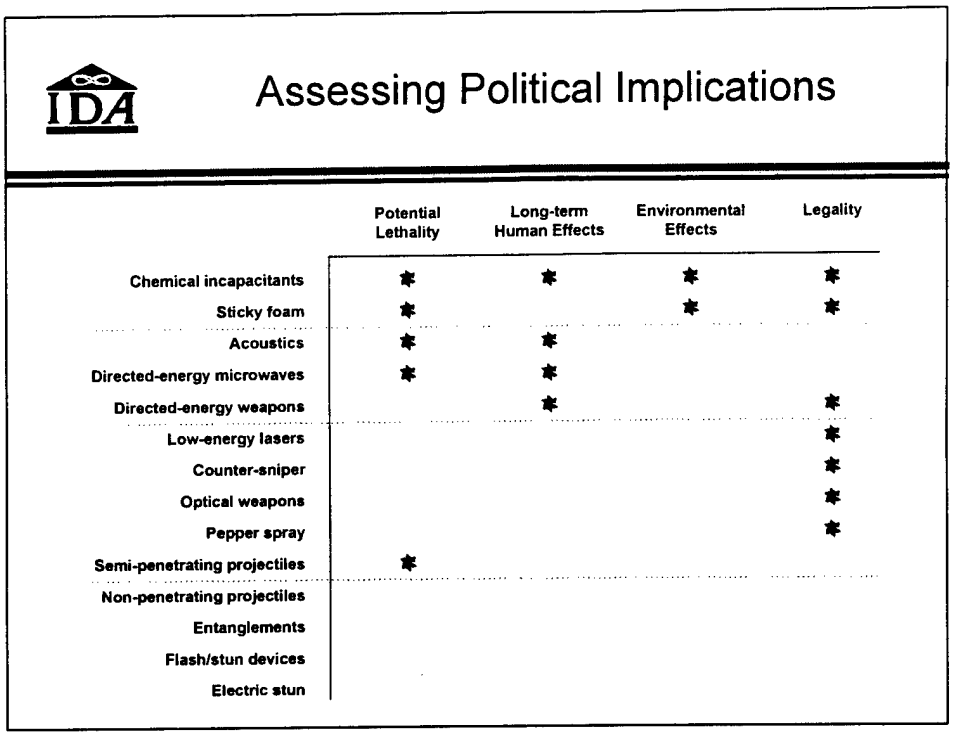
**Technologies with minimum logistics burden:**

- Flash/stun
- Non-lethal countersniper
- Non-penetrating and semi-penetrating projectiles
- Pepper spray

**These technologies offer a variety of target coverage options, but**

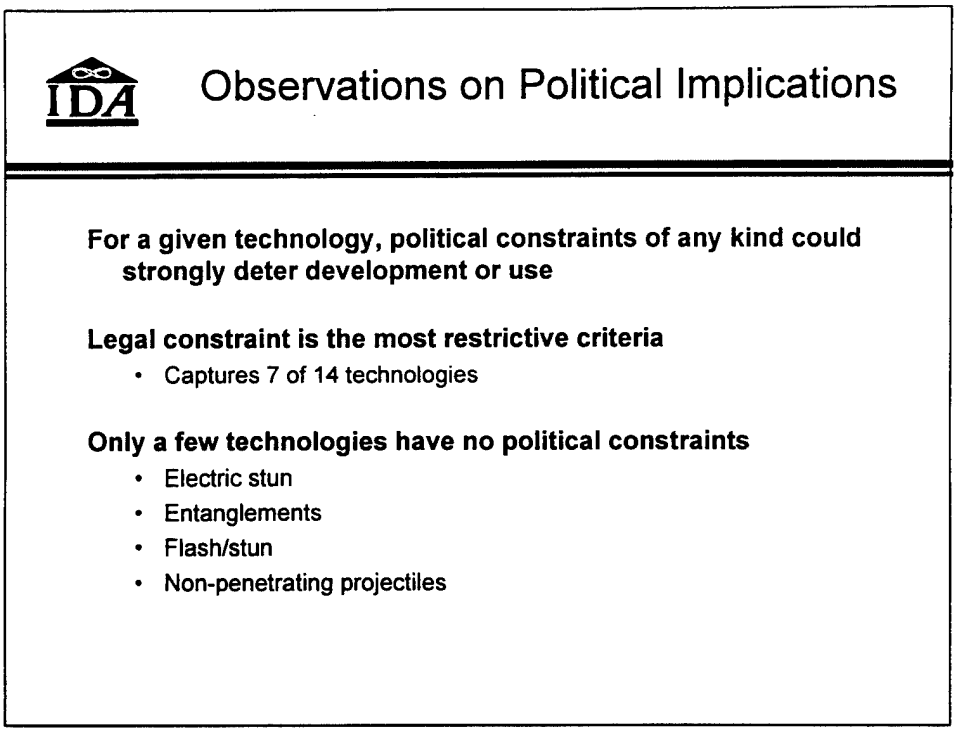
- Tend toward lower end of force continuum
- Are primarily short range
- Are susceptible to countermeasures

The purpose of this portion of our assessment, simple as it is, is not to measure the potential logistics burden associated with a given technology, but rather to flag instances where relatively more severe logistics burdens may arise. We found many technologies that appear to have little or no associated burden, yet these technologies have many other drawbacks. In particular, they tend to cover only a portion of the force continuum, are primarily short range, and are relatively more susceptible to countermeasures than other technologies.




Our assessment of political implications was conducted in the same fashion as our assessment of potential logistics burdens. We found a similar distribution of technologies: a few with severe political drawbacks, a few with none at all, and most clustered somewhere in between.

On the issue of legality, we gave demerits both to technologies already restricted by treaty and to others whose concept appears to violate the spirit of existing agreements. The latter are primarily those likely to fall under the Convention on Certain Conventional Weapons (CCCW), which seeks to ban inhumane forms of warfare. Under the auspices of the CCCW, some nations and international organizations are today attempting to mandate bans on the use of anti-personnel landmines and laser blinding weapons. It is easy to make the intellectual leap from these systems to microwave systems that cook people from the inside out if they get too close.




Political implications differ from logistics burden in that political constraints of any kind could prove fatal for future development or use. Systems likely to cause long-term disabilities such as blindness or organ failures in a high percentage of the targeted population may be simply untenable in operations other than war, where our primary objective may be to improve the lives of the local civilian population. Since only a handful of technologies meet all four criteria, decisions to alleviate one set of political problems through the use of non-lethal technologies may in the end merely create another set of political problems.

Of the political criteria we used, legal constraint is the most restrictive, capturing half of the examined technologies in the way we have applied it. However, legal constraint is the most easily manipulated since international agreements can always be amended or superseded and are so designed in part to take advantage of advances in technology. Yet while a technology should not be rejected out of hand because of potential legal constraints, decision-makers need to weigh the potential benefits of the technology against the political capital and other costs of negotiating changes in agreements. While somewhat beyond the scope of this presentation, we recommend that legal reviews begin early in the development process for individual technologies and be revisited periodically as development proceeds.

## Summary: Utility of Non-lethal Technologies for Crowd Control

**Projected development program leaves gaps in some operational capabilities**

- Preventing crowd formation
  - Limited ability to discriminate at long range
- Controlling crowds
  - Limited ability to escalate to upper end of force continuum at short range
  - Countermeasures of particular concern against short range systems

**Political considerations will deter development and use of many non-lethal technologies**

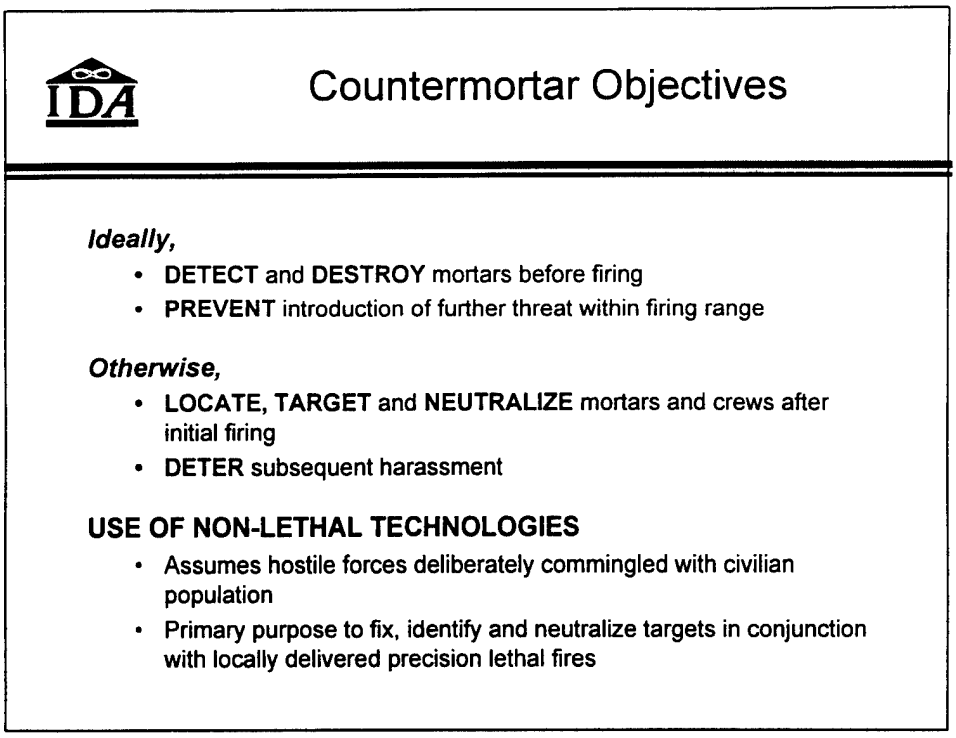
**Use of non-lethal technologies will impose at least some logistics burden**

- May stress logistics system or reduce other capabilities

This slide briefly summarizes the results of our assessment of the utility of non-lethal technologies in crowd control operations. We discovered that while the non-lethal technologies we examined can fill some gaps in our capabilities, it is not clear that they can fill all gaps. Even where they do contribute, the development and use of non-lethal systems will have associated logistics and political costs that need to be carefully considered.

## C. ASSESSMENT CASES II AND III: COUNTERING HARASSING MORTAR FIRE AND MAINTAINING A PROTECTED ZONE

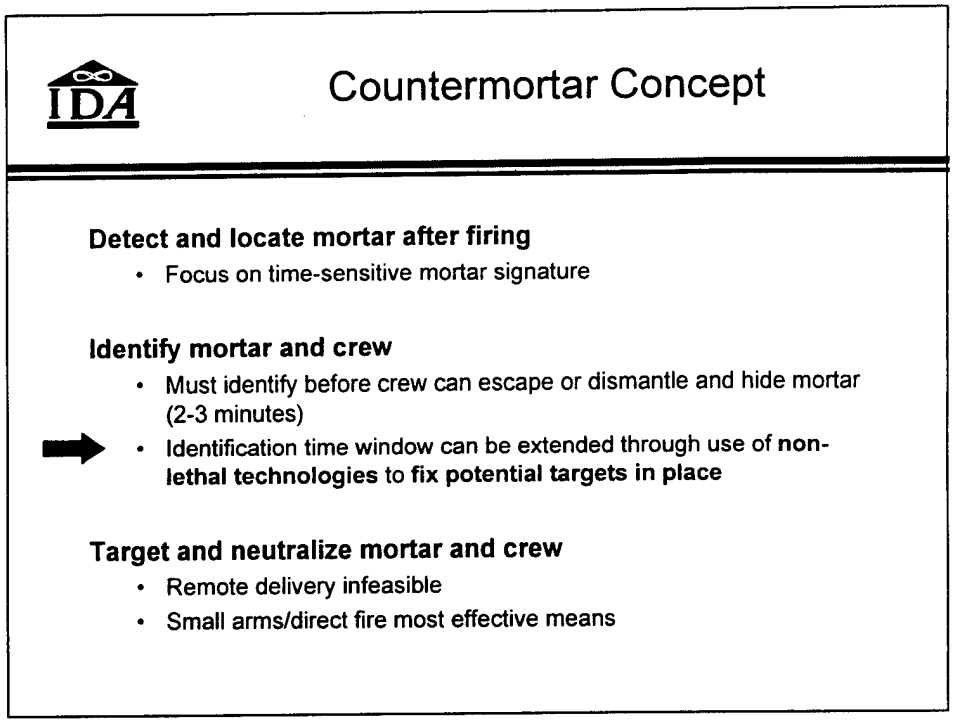
We now take a brief look at our two other case studies, countering harassing mortar fire ("countermortar") and maintaining a protected zone ("perimeter security"), to determine the potential applicability of non-lethal technologies for enhancing these capabilities. As in the crowd control case, we'll begin by looking at the mission objectives and what they imply for capability requirements. We'll then compare those requirements for the two cases and show how the differences between them affect the relative merits of various technologies.




In countering harassing mortar fire, one would ideally like to detect and destroy mortars before they fire. This is particularly true if mortars are being used, as in Bosnia, to target marketplaces and other areas where civilians mingle in the open. In such cases even one lucky mortar hit could kill dozens of innocent people.

Unfortunately, mortars themselves do not have a detectable signature unless they have been fired, and crews are impossible to distinguish from ordinary civilians. This means efforts to detect and destroy mortars before they've been fired will depend primarily on luck or happenstance. Instead, the best we can hope to do is to exploit the strong signature associated with mortar fire to ensure that no given mortar can fire more than once before being destroyed.

In many cases, this objective can readily be accomplished through the use of traditional counterbattery fire. However, it is possible that hostile mortar crews would deliberately mingle with civilians in order to shield themselves from remotely delivered return fire, which typically cannot discriminate sufficiently to prevent civilians from being killed. Should this happen, non-lethal technologies could provide a means of fixing the mortar crew in place, so that U.S. forces could follow with locally delivered precision fires.




The countermortar concept is further elaborated in this slide. Mortar crews must be distinguished from the commingled civilian population before they can be targeted, even with very precise lethal fires. Yet because they can dismantle their weapons and flee the area in only a few minutes, the opportunity for identifying, and subsequently targeting and neutralizing, the crew is very limited. If non-lethal technologies could be used effectively to prohibit movement in the vicinity of the mortar fire, however, they might be able to extend the time window sufficiently to allow local identification.

## Perimeter Security Objectives

***Ideally,***

- **PREVENT** infiltration of perimeter

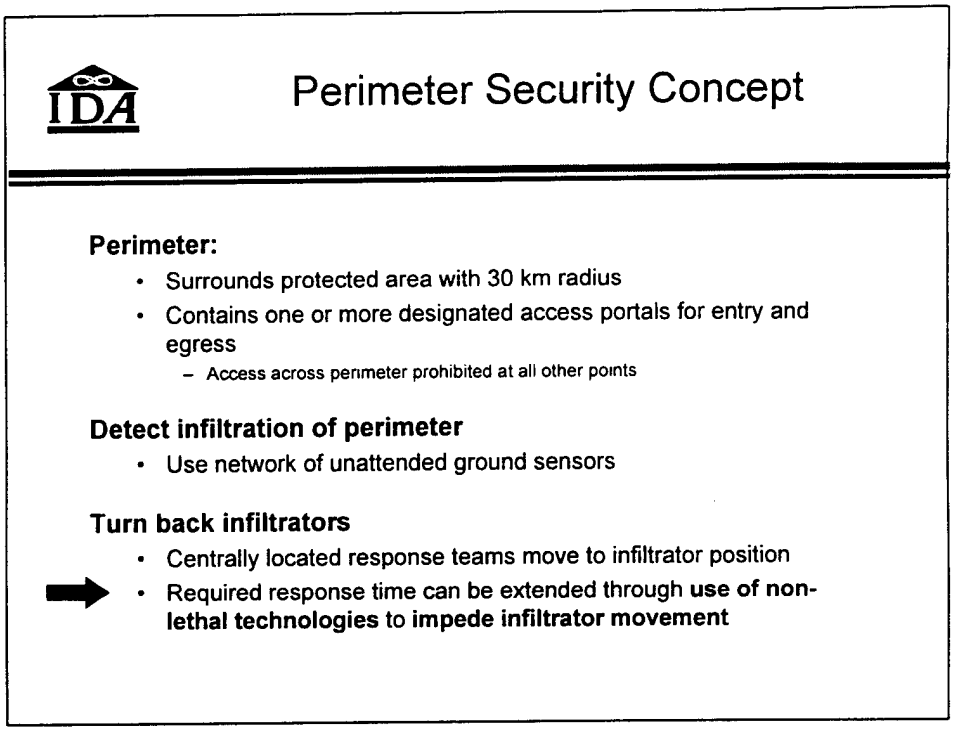
***Otherwise,***

- **DETER** infiltration
- **DETECT** and **TURN BACK** infiltrators
- **FACILITATE** efficient transit of authorized personnel
- **MINIMIZE** personnel security requirements

**USE OF NON-LETHAL TECHNOLOGIES**

- Assumes US involvement is neutral
- Assumes not all intruders are hostile
- Primary purpose to slow intruders until response team arrival

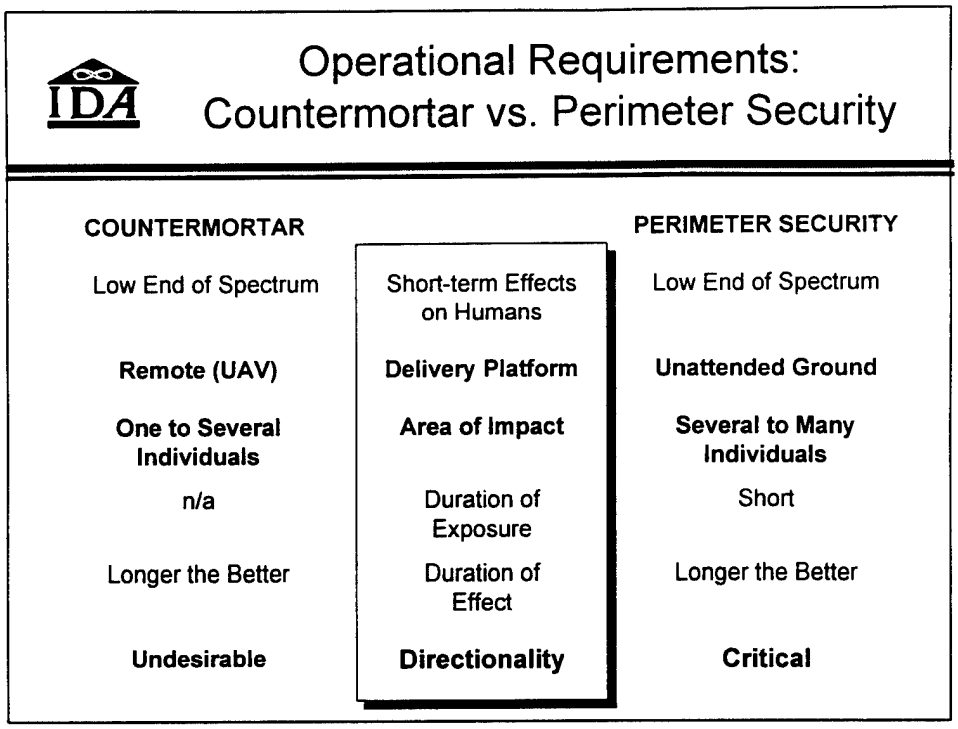
In maintaining a protected zone, the role of non-lethal technologies is very similar to that in countering harassing mortar fire. Assuming U.S. forces are acting in a neutral capacity, and assuming that not all intruders are hostile, our objective is to turn back intruders, not kill them. In this case, the primary purpose of non-lethal technologies is again to inhibit movement in the area of infiltration until response teams can arrive.



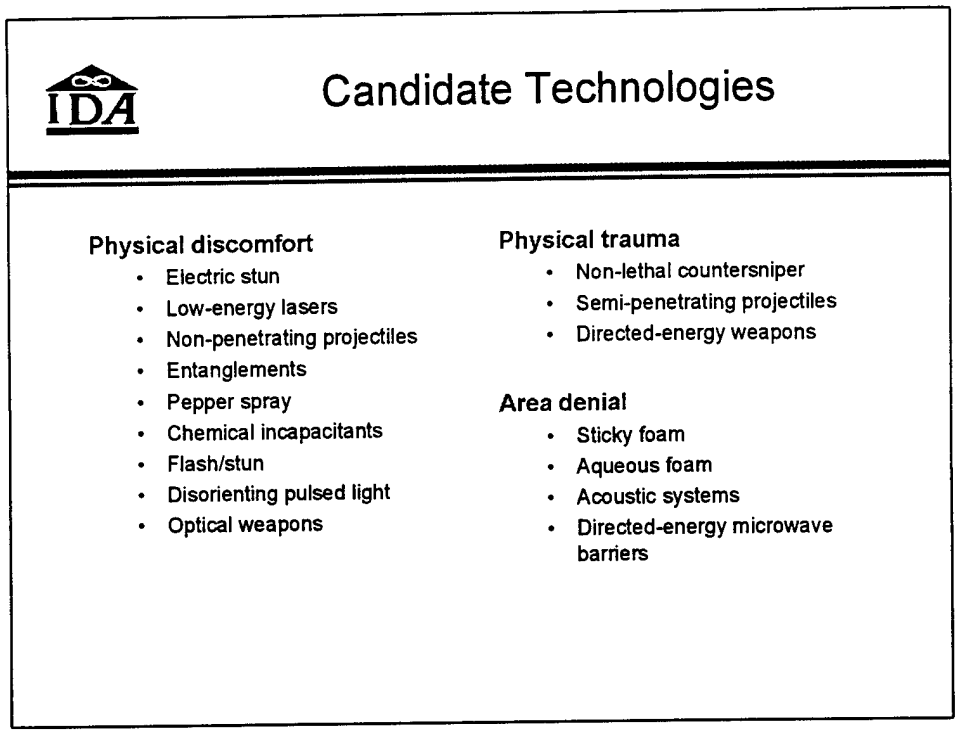

This slide further outlines the perimeter security concept. The perimeter as we have defined it surrounds a protected area with a 30-kilometer radius. This perimeter contains one or more designated access portals for entry into the protected zone; access across the perimeter at all other locations is prohibited. Unattended ground sensors would be arrayed along the perimeter to detect any crossings; centrally located response teams would then move to the point of infiltration to turn back intruders.

The speed with which intruders can advance beyond the perimeter has important consequences for both the success of response team operations and the efficiency with which they can be carried out. The more slowly intruders are forced to move, the closer to the perimeter they can be confronted, making it easier to turn them back. Slower-moving intruders allow response teams more time to respond, which in turn allows them to cover longer distances. This may allow a given perimeter to be protected with fewer numbers of response teams, generating economies of force.

In this concept, the role of non-lethal technologies is to slow or halt intruder advances for as long as possible.




In this slide, we take the objectives and concepts developed for countermortar and perimeter security operations and compare them based on their associated operational requirements. As we can see, despite the similar roles of non-lethal technologies in both cases, the differences in operational context seem to drive us to very different systems. For example, perimeter security systems must be directional to avoid exposing response teams to their effects. On the other hand, directionality is undesirable in countermortar operations, given that we want to affect everyone within some given radius of the mortar firing location. Similarly, in the countermortar case we want to minimize the effects on innocent bystanders, and therefore want systems with limited target coverage. In the perimeter security case, however, such systems might be overwhelmed if the number of intruders is large; we would instead prefer systems that provide area coverage.




Given these operational requirements, which technologies provide the greatest capability for these two cases? We again evaluated the set of anti-personnel technologies shown earlier and repeated here.

## Matching Technologies and Requirements

**COUNTERMORTAR:**

- Requirements dominated by need for remote delivery, small area of impact
- **ENTANGLEMENTS** have comparative advantage

**PERIMETER SECURITY:**

- Requirements dominated by need for area coverage, directionality
- **ACOUSTIC SYSTEMS** have comparative advantage

Not surprisingly, we discovered that the difference in operational requirements, not readily apparent at first, led us to prefer different technologies for each case. For countering harassing mortar fire, we found that given the need for remote delivery, combined with the desirability of a small area of impact, entanglement systems had the greatest merit. Alternatively, for maintaining a protected zone, we found that given the need for area coverage and directionality, acoustic systems had the greatest merit.

## Observations

**Operational requirements can vary greatly among apparently similar missions and objectives**

**Different missions will require different technologies**

- Technology decisions must consider operational requirements

**Non-lethal technologies often most effective when used in conjunction with conventional forces**

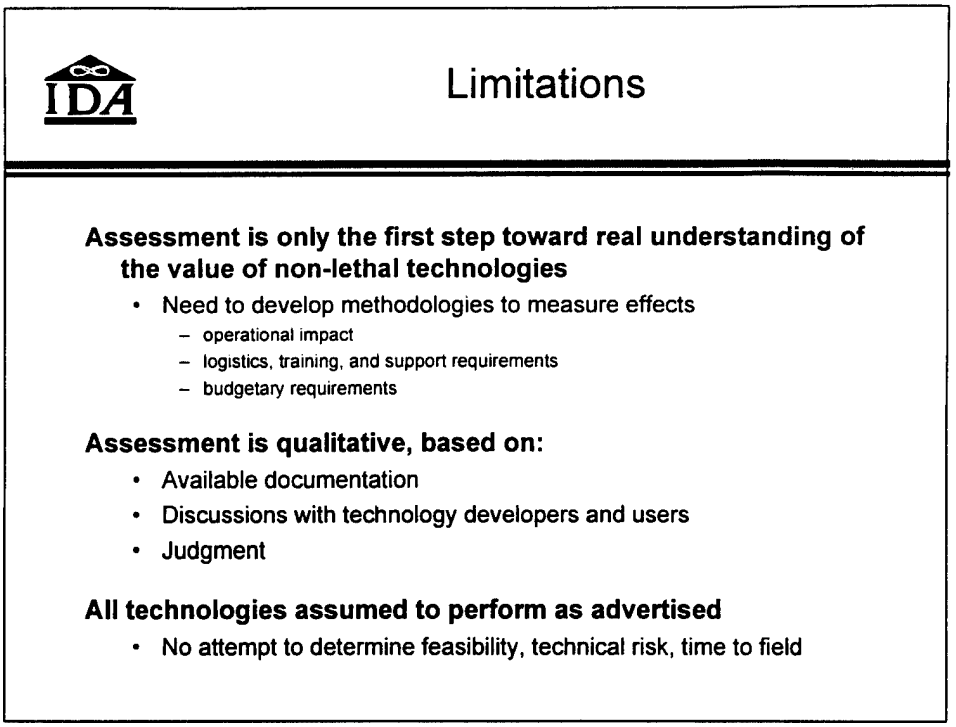
- Create new capabilities
- Improve efficiency or effectiveness of existing capabilities

Looking at the countermortar and perimeter security cases demonstrates the need to evaluate non-lethal technologies in the operational context in which they will be used. Even missions with apparently similar objectives can have quite different operational requirements, which will in turn drive technology solutions in different directions. This means that different missions will require different technologies: there is no silver bullet technology that will meet all OOTW requirements; development of a varied and robust non-lethal capability will have greater payoff than development of only a few technologies.

One final, more implicit observation on these two cases concerns the broader role of non-lethal systems. In both instances, non-lethal technologies were used in conjunction with existing conventional forces to create new capabilities in the countermortar case and to improve efficiency and effectiveness in the perimeter security case. This suggests that non-lethal technologies perhaps have application beyond operations other than war, as a means of enhancing combat capabilities in any environment where civilians might be present.

## III. LIMITATIONS, SUMMARY AND CONCLUSIONS

We conclude with a discussion of the limitations of our work to date, a brief summary, and some conclusions.




The most obvious limitation on our work to date is its purely qualitative nature. What we have discussed is based on available documentation, discussions with technology developers and users, and our own professional judgment. We have not yet had the time or resources for developing methods to measure the effectiveness of these technologies in the roles we have assigned them.

Second, we have not conducted any technology feasibility studies, assessed technical risks, or projected development timelines. Instead, we have simply assumed that all technologies perform as advertised.

Third, no real assessment of non-lethal technologies would be complete without analysis of stockpile requirements or budgetary impacts. Finally, we have not examined any classified programs.

## Summary

**In OOTW, the primary role of non-lethal technologies is to bridge the gap between no force and lethal force**

**Different technologies have different operational characteristics**

- Nature of effect
- Range
- Area of Impact
- Vulnerabilities
- Etc.

**Non-lethal technologies are useful in a wide range of OOTW**

- Operational requirements drive utility of a given technology

The following are the most important observations to emerge from our case studies.

- Non-lethal technologies bridge the gap between not using force and using lethal force.
- Different technologies have different operational characteristics.
- Given that different missions have different operational requirements, non-lethal technologies can be widely applied. However, no single technology is the solution to all problems.
- Significant opportunities may exist for using non-lethal technologies to reduce collateral damage in conventional operations more generally.

## Bottom Line

**In OOTW, hostile forces have enormous incentives to exploit civilian populations**

- **For protection**
- **To further interests vis-a-vis US and allied forces**
- **To compensate for lack of conventional capability**

**The US cannot respond to this challenge today without:**

- **Increasing the risk to American soldiers, or**
- **Inflicting extensive civilian casualties**

**NON-LETHAL TECHNOLOGIES**
**HELP RESOLVE THIS DILEMMA**

Our bottom line: non-lethal technologies offer the only available means to balance the need to protect U.S. soldiers with the need to prevent civilian casualties in a way that allows us to successfully complete our missions.

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Since the end of the Cold War, the United States has become involved in a variety of operations other than war, ranging from small-scale disaster relief and humanitarian assistance missions to large-scale peace enforcement missions. Such missions have proven inherently ambiguous and often risky, particularly when the threat of civilian casualties and collateral damage has constrained the use of force. Non-lethal technologies, because they are intended to accomplish missions by means other than delivery of direct lethal force, promise to improve our capabilities in this area.

Non-lethal technologies potentially have broad application. The operational characteristics associated with individual technologies--range, area of coverage, nature and duration of effect, and delivery systems--vary widely. Since different missions have different requirements, the degree of variation among non-lethal capabilities increases the probability that at least one capability can meet a given mission's requirements.

This paper examines the opportunities and limitations which non-lethals offer in the context of operations other than war. It gives special consideration to concepts for crowd control, neutralizing combatants intermingled with non-combatants, and safe area defense.

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